

**Oceanography Committee**

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**REPORT OF THE  
WORKING GROUP ON PHYTOPLANKTON ECOLOGY**

**Narrangansett, Rhode Island, USA**

**5–7 April 2000**

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## **1 OPENING OF THE MEETING**

The host, Professor Ted Smayda opened the meeting at 9 am on the 5<sup>th</sup> of April. He welcomed the participants to the Working Group Meeting, being held at Graduate School of Oceanography, University of Rhode Island, USA. The Deputy Dean, Dr. Kenneth Hinga welcomed the participants and gave a short information of the Graduate School of Oceanography. The chairman Dr. David Mills started the meeting with a series of announcements, mainly regarding practical details.

Eight members attended the meeting (Annex 1). A few members were unable to attend and had informed the Chair. There was no participation from Denmark, the Baltic countries, Poland, Russia, Belgium, Finland, France, Ireland and Portugal. Efforts should still be given to try to involve more scientists in the work of the Working Group on Phytoplankton Ecology, as many interesting scientific and applied problems are discussed within the group (eutrophication, growth rates, food web structures, global change, operational monitoring strategies, global change etc.). The task of acting as rapporteur was shared among the participants.

## **2 TERMS OF REFERENCES, AGENDA AND AVAILABLE PAPERS**

The Terms of Reference (Annex 2) were considered and the chairman presented the Agenda for the meeting (Annex 3).

## **3 DISCUSSION OF TERMS OF REFERENCE**

**TOR a. identify the facilities, resources and protocols required to conduct a mesocosm experiment on flagellate physiology and behaviour**

The WG noted that little progress had been made since the last meeting. However, despite lack of activity the underlying interest within the group remained strong. The critical factor limiting progress was availability of time. The WG recognised that there needed to be a convergence of the current work areas of the WG members to enable the commitment of the necessary resources to develop this proposal further and to carry out the proposed study. A sub-group of the WG plan to meet inter-sessionally to discuss further the resources necessary to carry out the proposed study.

**ToR b. prepare for a joint session with WGZE in 2001 on the development of improved understanding of phytoplankton-zooplankton interactions**

The WGPE discussed the proposed joint meeting and propose a two-day meeting to be held in Bergen in the weeks beginning 26<sup>th</sup> March or 23 April 2001. The working group identified the need for pre-meeting preparation by establishing early contact with WGZE via the chairs to confirm the focus of the discussion and coordinate planning. Following review of the previous items for discussion the list has narrowed to include the following items:

Ecosystem understanding requires increased knowledge of the following aspects of phytoplankton-zooplankton interactions:

- i) the limits to modelling phytoplankton - zooplankton interaction
- ii) species - species interaction, for example in terms of selective grazing
- iii) can a collapse in grazing pressure lead to symptoms of eutrophication?

In particular, the WGPE identified a need for an organismal focus in the joint discussions.

Prior to the next meeting it is suggested that individual members of each group agree to prepare material for presentation at the joint meeting and that this is circulated to members of both working groups to facilitate discussion. Furthermore, WGPE have identified a need to attract a microbial ecologist to participate

**ToR c. assemble a list of long-term time series of plankton and associated environmental variables and to discuss the possible development of an ICES-wide database on these parameters**

The WGPE has in the last years maintained an increasing interest in long term time-series with particular concerns over their protection and in their utilization to address a range of questions regarding environmental change. One of the results of this interest has been the organization of the ICES Marine science Symposium "The Temporal Variability of Plankton and their Physico-Chemical Environment" held in Kiel, Germany in 1997.

During this year meeting the WGPE had as a task to assemble a list of long-term time series of plankton and associated environmental variables and to discuss the possible development of an ICES-wide database on these parameters.

The WGPE started the discussion on this item by exchanging opinions on the feasibility of creating a database for these long-term time series. It became rapidly clear that the necessary resources to achieve such a task were of considerable dimensions well outside the capabilities of the WGPE. The WG became also aware of similar initiatives inside the European Union. In view of these facts, the WGPE decided to wait with the continuation of the work on a database and concentrates its efforts in starting the work towards the creation of a meta-database at ICES headquarters. The WGPE is of the opinion that the creation and maintenance of such a meta-database is an affordable task for headquarters.

The WGPE is also aware that some confusion can arise between what is understood as long-term time series and monitoring programs given the fact that in many cases there is some overlapping in the kind of variables being measured in the two approaches. The WGPE agreed, for example, in that the measuring of chlorophyll alone is not a valid criteria in order to identify a measuring program as a long-term time series of plankton. The latter are focused mainly to obtain information to understand how the ecosystem works and react, i.e. to environmental changes.

The WGPE, after agreeing on the above items, started the discussion about which criteria to consider for creating the meta-database. In this respect, the WGPE agreed that:

A long-term time series must have a lifetime over 5 years, that the time series should include all protists, but with special attention to phytoplankton.

The following information should be included in the meta-database:

- Country of origin
- Reason for the program
- Location (geographical)
- Sampling strategy:
  - single/multiple stations
  - single/multiple sampling depths
  - sections/area surveys, etc.
- Parameters:
  - Physical: i.e. irradiance, meteorological, hydrography, etc
  - Chemical: i.e. nutrients, oxygen, etc.
  - Phytoplankton species composition
  - Biomass: i.e. Chl. a, POC/PON, etc.
  - Primary Production: i.e. method
  - Zooplankton
- Frequency:
  - regular/irregular
  - weekly/monthly/seasonal
- Start/End of the program
- Responsible Institution/person: address, e-mail etc.
- Notes/Miscellaneous, i.e. form in which data exists.

A first compilation of long-term time series provided by the WGPE attending members was not possible to compile at the meeting and will be undertaken inter-sessionally. The need to reach to other members of the WGPE will be covered by a letter from the Chairman of the WGPE to them asking for contribution from their countries to be included in the meta-database in the inter meeting period.

For internal action:

Persons to be contacted and by whom:

- Denmark (Hanne Kors) by Lars and letter

- Fzeröyene (Eilif Gaarder) by Kristinn and letter
- Spain (Antonio Bode) by letter
- Portugal (Teresa Moita) "
- Cathryn Bellam (France) "
- Belgium (C Lancelot) "
- Poland, Lithuania, Latvia, Estonia, Finland by Lars
- Russia to be determined

**ToR d. develop proposals for a workshop on the role of anthropogenic forcing in planktonic ecosystem change to be held in 2001**

The WG agreed that there was a continuing concern regarding the effect of anthropogenic nutrient inputs to coastal ecosystems and the role of phytoplankton mediating that effect. However that concern was not necessarily shared by all ICES countries. For example, within the USA there was resistance to the idea that anthropogenic nutrient input could result in altered phytoplankton dynamics. The view of the WG was that there was lack of consensus due to confusion and that bearing in mind a number of new studies and results (e.g. the UK Joint Nutrient Study – JoNuS). The WG agreed that they should prepare a recommendation for Workshop to be carried out in 2002 to include title, names of chairs, location, date, terms of reference, and justification and background.

**ToR e. develop criteria for inclusion of species in the phytoplankton checklist and to circulate it for comments**

The WGPE reminded itself of the role of SGPHYT (Study Group on Phytoplankton Checklist). This group was set up by the Oceanography Committee at the Annual Science Conference 1999 after a recommendation of WGPE. The aim of the ToR is to:

- revise current lists of taxonomic groups of algae
- set up new lists of taxonomic groups of algae
- prepare a clearly formulated criteria for inclusion of a species

SGPHYT will report to WGPE and to the Oceanography Committee at the 2000 Annual Science Conference.

During the WGPE meeting, the criteria and format of a checklist were discussed. It was concluded that the identification of phytoplankton species is at a stage where optical techniques and molecular probes are rapidly developing. At the same time, it was stressed that there is an ongoing and obvious need for knowledge on species identification from microscopic analysis.

During the discussions of the criteria for inclusion in the checklist, two things became clear. First, what is usually included in the phytoplankton checklists and is analysed as phytoplankton also covers other groups of organisms. Heterotrophic microplankton, e.g., Protozoans, Ciliates, Choanoflagellates, as well as Cyanobacteria, are examples of this. The checklist should therefore not be called a 'Phytoplankton Checklist', but a 'Microplankton Protist List'.

Second, the amount of information, that is desired in a list of this kind, is so large that it is no longer accurate to call it a checklist. It was suggested to use the working name: 'Relational database of Microplankton and Protists'.

It was also concluded that, although a considerable amount of information, including pictures and sizes of the species, have been suggested for inclusion in the database, the list is not meant to be used for identification.

At present a questionnaire is being compiled, in which phytoplanktologists are asked to give their opinions on specific items of information to be included in the list. It is anticipated that the criteria and format of the list will be ready for presentation at the ASC in September 2000. At that time the 'full' list of existing checklists will be presented. From then on, the work with the compilation of the new complete list will start. The first step will be to control that the species (a) meet the criteria for inclusion and (b) are taxonomically sound. This work will initially be done by correspondence, but at a later stage workshops are anticipated.

The list should/may include:

- species name

- b) synonyms
- c) author
- d) year
- e) literature
- f) autotroph/heterotroph/mixotroph
- g) pictures
- h) sizes
- i) shape
- j) formula for volume
- k) volumes (ref.)
- l) formula for plasma volume
- m) plasma volumes (ref.)
- n) formula for surface area
- o) surface area (ref.)
- p) equipment for identification
- q) unit to be counted (cell, chain, colony)
- r) distribution area
- s) season

The particular advantages of a database are:

- it can be searched using multiple search criteria
- it is easy to expand to enable incorporation of more recently available information
- it is easy to update and therefore, more future proof.

#### **ToR f. Review the reports of SGQAB/SGQAE**

#### **4 SGQAB**

Lars Edler reported from the meeting in February 2000.

The ICES Annual Science Conference 1999 concluded that the work of the SGQAB should be continued, as the proper QA procedures are a prerequisite for the COMBINE Programme.

It was agreed that no changes in the plankton sampling depth from 0 –10 m to 0–20 m should be allowed before the possible effects are investigated and well documented by ICES/HELCOM Workshop/Training Course on Phytoplankton. This material should be prepared and submitted to SGQAB for further evaluation.

The updating of the taxonomic checklists should be continued. The need of providing of identification material on the Internet was stressed. *For phytoplankton, the Working Group on Phytoplankton Ecology could coordinate this process.*

The necessity to have annual ring tests was emphasized and the SGQAB has been requested to develop the regular ring tests for all core and main biological variables in the COMBINE programme.

SGQAB expressed the opinion that taxonomic checklists should be prepared for each region separately and the compilation is made by the relevant ICES Working Groups.

EC HELCOM has stressed the importance of intercalibration and intercomparison exercises and accepted to start the proposed [Alg@line](#) Project of phytoplankton intercalibration for the HELCOM COMBINE work.

The working manual and supporting papers on the use of a standardized incubator-technique in primary production measurements was adopted by EC to be included in the COMBINE Manual.

With respect to work on QA of biological measurements, further work has continued but a question has arisen regarding a recommendation of the Workshop/Training course on Phytoplankton that the sampling depth be changed from 0–10 m to 0–20 m. As the Workshop has not provided information on the possible effects of this change on the results of phytoplankton monitoring, ICES has requested that detailed supporting material be provided on this subject so that an informed decision can be made.

The ICES/HELCOM Phytoplankton Training Course was held in October 1999. During the Workshop the participants had lectures on taxonomy of blue-green algae and the genus *Chaetoceros*, reviewed the current status of phytoplankton counting program PHYTOCOUNT and the Baltic phytoplankton checklist. The ICES draft reporting format for biological community was commented. Future plans of the Expert Group for years 2000–2002 were outlined. It was decided that the biomass sub-group should meet intersessionally to complete the work on species volumes.

SGQAB expressed the opinion that most significant QA items are sufficiently covered by the work of Phytoplankton Expert Group. SGQAB requested the Expert Group to consider the outcome of both intercalibrations in 2000 by [Alg@line](#) Project and BEQUALM and report the evaluation to SGQAB.

Concerning the new manual for chlorophyll determination the WGPE has started to collect the results of intercomparison exercises between different extraction solvents from laboratories. SGQAB supported the opinion that WGPE should continue its activities in the data compilation and evaluation and subsequently produce a recommendation for the HELCOM COMBINE Manual.

The Manual for Primary Production Measurements was completed in February, 1999 and later accepted by HELCOM EC 10. Now, as a part of the COMBINE Manual it describes a standardised incubator technique, compared to the previous manual and the incubator with clearly defined light sources, including manufacturers. Although there is some delay in further development of the Manual the needed changes are defined and the completing and updating of the Manual is considered as a priority. SGQAB forwarded its thanks to WGPE and F. Colijn and L. Edler, particularly, for their significant contribution. In order to have an idea on the present situation of use of the new method in the HELCOM area, SGQAB decided to have a questionnaire. The results will then be reviewed by the next SGQAB meeting. Also the review of progress in updating of the Manual will be the next year's task of the SGQAB.

Lars Edler, as Chair of the Study Group on an ICES/IOC Checklist of Phytoplankton, introduced SGQAB with the current situation. The questionnaire is planned to be sent out on criteria for having the checklist. It is planned to divide the checklist according to different marine areas. SGQAB recommended to use the present Baltic phytoplankton checklist and therefore to request the Finnish Institute of Marine Research to put it into Internet for consideration by experts and filling in the missing information.

SGQAB had a discussion concerning the test version of ICES Biological Data reporting formats at the joint session with ICES/OSPAR SGQAE. ICES gave an overview of the comments received by ICES from the Phytoplankton expert group and Finnish Environment Institute. ICES gave an explanation concerning the delay in the delivery of the final version of the data reporting formats and data entry program. SGQAB expressed the deep concern in such a delay and asked ICES to speed up the process of finalizing the biological data entry program. No final agreements were made, as no test versions of the data entry program were available.

SGQAB asked the ICES to contact persons developing the HELCOM PHYTOCOUNT programme to agree on possible cooperation in the preparation of data entry programs. As the programme for counting of phytoplankton already exists and is paid by HELCOM there is no need to develop such programme by ICES.

The importance of an updated species lists for the HELCOM area was again stressed and the need of establishing such an officially approved lists was underlined during the discussions. As the biological data entry programs fully depend on the existence of these lists, immediate actions have to be taken to provide the ICES data center with these lists.

SGQAB was informed of the progress in updating and maintenance of the HELCOM Baltic Sea phytoplankton monitoring data. The counting program is expanded to include species from the entire Baltic Sea areas with the RUBIN Coding, size classification and cell volumes as recommended and discussed by the phytoplankton experts. All the species from the new checklist updated 21.9.99. have been added to the phytoplankton counting program species file and new size classes cell volumes have been started to incorporate according to the decisions made in the 1998 and 1999 Expert meetings.

Concerning the current status of the new Checklist of Baltic Sea Phytoplankton Species compiled by Guy Hällfors, a Draft Version No. 1 is ready to be distributed with short notice as a CD-ROM file to the members of the HELCOM and ICES phytoplankton working groups, with a request for constructive comments and help in finding missing data and



missing articles. The Draft Version No. 2 will be posted on the Alg@line website for further comments from the international community of phytoplanktologists in autumn 2000, and the final version will be ready for printing in spring 2001.

The Phytoplankton Intercalibration for the HELCOM COMBINE Work Programme Initiated by the Alg@line Project will start in March this year and the compilation of the results is planned for November. Then also the final report will be made available to the Phytoplankton Expert Group and the ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements for their evaluation and synthesis.

## **5 SGQAE**

From the SGQAE report, having its meeting in February 2000.

Relevant items from WGPE included a review of a draft ICES standard procedure for chlorophyll *a* determination; WGPE proposed to adopt the specified methodology noting that, if other methods were used, then these must be shown to produce comparable results. However, it was noted from the report of Lars Edler to SGQAB 2000 that developmental work relating to this manual is continuing. See also SGQAE comments under Section 12, below.

WGPE also noted the importance of a checklist of phytoplankton species for the ICES/OSPAR area for the effective input, use, and archiving of biological data in the ICES database.

SGQAE also took note of the generally encouraging outcome of a QUASIMEME laboratory performance study for the determination of chlorophyll *a* and phaeo-pigments in sea water ('QUASIMEME Laboratory Performance Studies Round 17'. Report for Exercise 386 m DE-6 Chlorophyll *a* in Sea Water and Standard Solutions, April to June 1999).

Dr Heye Rumohr gave a review of the progress of the BEQUALM project, in particular, work packages 8 and 9 (Phytoplankton communities and Chlorophyll *a*, and Benthic Community Analysis, respectively). He informed SGQAE about the second BEQUALM newsletter that was recently issued and can be downloaded from the CEFAS web page at <http://www.cefas.co.uk/bequalm/bequalmnews2.pdf>.

In the Joint meeting between SGQAB and SGQAE the Draft ICES Biological Data Reporting Format was presented and discussed. For the time being, the database will be kept in ASCII – DOS format. However, three possibilities for entering data in the future are planned:

- 1) ICES reporting format that is described in the 'ICES blue book'. The list of parameters to be included in the biological database was presented and commented on by SGQAE participants. As these are still draft formats, further comments to the list can be sent to J.N. Jensen by e-mail.
- 2) BDE – Biological data entry program, which is still under development, for reporting bodies that have not yet developed a base structure for biological data.
- 3) Spreadsheet-type reporting system that will make it possible to report using, e.g., Excel or Access. This system is under development.

J.N. Jensen took note of written comments submitted by Germany, Belgium, and the UK.

There was a strong demand from the delegates to develop the spreadsheet format for the data entry system, and frustration at the continued delay. Some of the delegates indicated that they would not be able to supply biological data to ICES until Option 3 is available. Germany refused to use the draft ASCII-format for biological data and will not submit biological data until the database has been transformed to a relational system to meet modern standards and the possibility to submit data in tabular (Excel, Access) or spreadsheet form has been developed.

J.N. Jensen acknowledged this problem which is partly a function of constraints imposed on ICES by earlier specifications for the database structure and partly due to manpower limitations. The difficulty with further development of Option 3 (above) should be resolved with the planned appointment of an ICES database manager, which is expected as early as November 2000. The development of Option 3 might therefore not be finalised until mid-2001. ICES will also take an initiative to arrange a HELCOM/OSPAR workshop in November 2000, in order to gather practical instructions on data handling procedures (further minor amendments to the tabular data entry specifications were passed on to J.N. Jensen).

The Finnish delegate pointed out that the Contracting Parties of HELCOM and OSPAR are very disappointed about the delay in the development of the database, reporting format, and data entry system. He recommended that ICES be more flexible not only for the sake of ICES' reputation but also to meet actual data management needs.

The project European Register of Marine Species, sponsored by the EC, is nearing completion and a comprehensive list of marine species, together with documentation of taxonomic keys and experts in the field, should be available after March 2000. Information on this project is available via the internet at <http://www.erms.biol.soton.ac.uk/index.shtml>.

SGQAE discussed the draft for a chlorophyll *a* methodology prepared by Alain Aminot and Francisco Rey as a proposed standard procedure for the ICES area to be published in the ICES TIMES report series.

The standard method described is no longer the most common method used in many countries. SGQAE therefore recommends that the method be circulated to major research institutes and laboratories in the HELCOM and OSPAR areas for an additional expert review before it is accepted.

Dr Rumohr proposed the merging of SGQAE with SGQAB in view of significant overlap on many of the important QA issues of interest and the fact that both groups have suffered from low attendance and high turnover rates. This was strongly supported by SGQAE members.

SGQAE felt that there was a strong case for the inclusion of zooplankton in OSPAR/ICES eutrophication-related studies because of their potential value as an interpretative aid, e.g., with respect to interactions with phytoplankton populations, and as indicators of environmental degradation. (It was noted that zooplankton studies will be included as a component of monitoring work under the EC 'Water Framework' Directive). However, it was recognised that there would be a need to carefully identify measures appropriate to the robust estimation of changes in populations, e.g., diversity and biomass. As a result, SGQAE recommended that expert advice on the scope for the inclusion of zooplankton studies in monitoring programmes, including consideration of appropriate sampling and analytical measures, is sought from the ICES Working Group on Zooplankton Ecology (WGZE).

SGQAE noted with satisfaction that the long-awaited Zooplankton Methodology Manual (Harris *et al.*, 2000) has just been published. The Manual provides an up-to-date basis for the development of further QA measures in zooplankton investigations.

SGQAE also felt that there was a strong scientific case for the inclusion of a measure of primary production in ICES/OSPAR monitoring, because of the potential sensitivity of the measure to changes in eutrophication status. SGQAE recognised that, in addition to considerations of the accuracy and precision of a selected method, critical QA aspects include the importance of matching what is known about the process being measured with the timing and spatial scale of sampling effort. Automated measures (e.g., chlorophyll fluorescence) used in towed bodies or moored buoys may satisfy issues concerning spatial and temporal scales, but probably at the expense of precision of the measure. SGQAE therefore recommends that the ICES WGPE consider the practical benefits and drawbacks of the inclusion of currently available measures in eutrophication-related monitoring studies.

## **6 REVIEW ON COMMENTS ON CHLOROPHYLL PAPER**

Comments were passed from the Chair of SGQAE for consideration regarding the paper submitted by the WGMC and WGPE on analysis of chlorophyll concentration. Bearing in mind the acceptance by ICES of the paper no further discussion was deemed to be required by the WGPE.

## **7 REVIEW OF ANNEX 8 OF THE REPORT OF THE SGQAE**

A number of amendments and corrections have been proposed for Annex 8 of the report. An amended version of the annex is included in the Annex 4 to this report.

## **8 ADDITIONAL MEASUREMENTS FOR EUTROPHICATION**

The WGPE were asked to discuss the value of additional measures in support of an assessment of eutrophication and in particular primary production and phytoplankton.

The desirability of incorporating primary production as an indicator of eutrophication was discussed. The lack of an agreed definition of eutrophication hampered the establishment of a consensus on whether primary productivity should

be measured. Clearly, an accelerated growth of algae, regarded as one of a series of indicators of primary eutrophication will not necessarily be detected by measurement of algal biomass alone.

If a need for measurement of primary production was accepted then a number of issues need to be addressed. It was pointed out that an inter-comparison exercise had been carried out in 1997 for measurements of primary production between a range of laboratories under the auspices of the WGPE. In brief, the results showed considerable discrepancies between laboratories which arose due to a variety of different factors ranging from practical to data processing aspects. It was concluded that a standard procedure would be required for all participants if consistent results were to be obtained. Arising from this initiative has been a design for an ICES standard incubator that could be adopted in a standard procedure if desired.

It was noted by the WG that HELCOM has agreed to adopt the standard method described by Colijn (ref) which incorporates the use of the ICES standard incubator.

Further discussion by the WG identified the need to remain aware of other important factors including sampling strategies to resolve spatial and temporal variability at appropriate resolution and the need to be aware of emerging methods for measurement of primary production including bio-optical methods such as measurement of variable fluorescence.

**ToR g. consider and, where feasible, develop data products and summaries that can be provided on a routine basis to the ICES community via the ICES website**

The group discussed the issue of data summaries and clarified the rational for providing fast access to data products in the ICES community. It was pointed out that this kind of information is already available in several instances at member websites. As a result all that is needed is to link the respective websites to an ICES webpage. Additionally it may also be feasible, through appropriate channels, to encourage the making of similar cruise reports in those institutes that do not already taken on such practice.

**ToR h. examine the 1999 Oceanography Committee Working Group reports and the Terms of Reference for 2000 to identify where inter-group input could be provided or required with the view to formulating key questions requiring inter-disciplinary dialogue during concurrent meetings of the Committee's Working Groups in 2002**

We discussed a number of elements under this heading including:

- 1) Requests from the WGDM
  - opening a dialog with WGPE on workshop on formation of database of meta data on availability of biological oceanographic data
- 2) identification of time series data useful in interpretation of monitoring activities
- 3) Comments on a proposed new structure
- 4) Examination of WG reports and TOR's for 2000

#### Questions for inter-disciplinary dialogue during 2002

How do (phyto)plankton act as indicators of environmental change?

How can we identify and elucidate the causes of environmental change (natural, anthropogenic or climatic)?

Are there quantifiable links between physical controls of phytoplankton primary production and fish recruitment?

What are the newly emerging techniques that show promise for improved measurement and monitoring of the marine environment?

Do ecosystem models work?

How can we better link observational and modelling programmes?

What are the critical new scientific developments of relevance to the ICES community?

## **9 REQUESTS FROM THE WGDM**

(to develop a workshop on the formation of a database of metadata information concerning the availability of biological oceanographic data in 2001 or 2002;)

A discussion of the utility of developing a database of this type was discussed the membership identified a number of initiatives of a similar nature which suggested a possible duplication of activity. It was regarded as essential that the design of a (meta) database should take on board the wishes of the end users. It was not clear who the end users were for such a database.

Time series that would be regarded as useful in the interpretation of monitoring activities include;

- long term i.e. > 5 years
- Multi-variate e.g. with physical, chemical and biological measurements
- Internally consistent
- Rapidly available data
- Of sufficient spatial and/or temporal resolution to resolve the processes of interest
- With sufficient additional information to determine the limitations and strengths of the time-series measurements

## **10 NEW WORKING GROUP STRUCTURE**

The meeting felt that the broad focus of the WGPE gave us a unique position to address a wide range of inter-disciplinary issues not within the remit of other working groups. For example, despite the use of the word phytoplankton in the group name the work of the group necessarily encompassed microorganisms that did not contain chlorophyll but were better defined as protists. Nevertheless, phytoplankton play the fundamental role in the transfer of energy at the base of the food chain and provide a critical link between physics and the environment for growth of fish. As such, the work of the group has the potential to span the divide between ICES twin concerns of fisheries and environment.

Continuance of WGPE is recommended as a sub-discipline orientated group, to which a rotating topic orientated membership will be added. This combination of membership is needed to help WGPE to deal with specialised topics within phytoplankton ecology and requiring WG consideration. The accompanying remit and objectives define the scope and relevance of the basic disciplinary activities to be carried out by WGPE within which anticipated specialised topics needing reactive, proactive and inter-disciplinary WG considerations fall. A strong continued relationship with WGZE is desired whereas the current relationship with WGHABD might more appropriately be modified because of potentially overlapping activities of WGHABD and the proposed IOC/SCOR GEOHAB initiative. Should this WG re-organisation be need various options exist; WGHABD might be incorporated as a topic orientated group within WGPE. Alternatively, WGHABD might be restructured as a separate study group SGHABD acting semi-autonomously from WGPE as is the current case with SGPHYT. Whatever restructuring might be practical WGPE should not be dissolved but rather expanded to meet its ICES advisory capability on topic orientated and inter-disciplinary issues.

## **11 RECOMMENDATIONS AND RESOLUTIONS**

The WGPE recommends to maintain this group in the Oceanography Committee as a sub-discipline orientated group, to which a rotating topic orientated membership will be added. It is further recommended that the WGPE should not be dissolved but rather expanded to meet its ICES advisory capability on topic orientated and inter-disciplinary issues.

### **Justification**

There is a need to provide the Oceanography Committee and ICES with a combination of basic disciplinary activities as well as anticipated specialised topics within phytoplankton ecology. The importance of the WG activity is further highlighted by the multiple roles of WG members within a range of related ICES and international study group(s) and organisations and its wider contribution to scientific activities in our discipline.

### **Draft Resolution I**

The Working Group on Phytoplankton Ecology [WGPE] (Chair: Dr D.K. Mills, UK) should meet in Bergen, Norway, in March 2001 to:

- a) To prepare for a joint meeting with WGSSO in 2002
- b) review the reports of SGQAB/SGQAE
- c) Elaborate the outcome on the Study Group on and ICES/IOC Microplankton Protist List (SGPHYT)

- d) Identify appropriate web links containing data products of interest to the ICES community
- e) Prepare a recommendation for Workshop the role of anthropogenic forcing in planktonic ecosystem change to be carried out in 2002 to include Title, names of chairs, location, date, terms of ref, and justification and background
- f) To develop a full proposal for a joint mesocosm experiment dependant on identification of appropriate mesocosm facilities
- g) Discuss in a joint meeting with the WGZE the following major topics of common interest:
  - limits to modelling phytoplankton-zooplankton interaction
  - how do characteristics of phytoplankton diet (size, morphology, physiological condition, toxicity) influence of zooplankton ingestion rates, fecundity, viability, somatic growth and reproduction? (focussed to organism level when possible)
  - can collapse in grazing pressure lead to symptoms of eutrophication?
  - ways of improving the phytoplankton zooplankton components in GOOS.

### Supporting information

Priority:	The activities of this group are fundamental to the work of the Oceanography Committee, they are critical in understanding links between physics and Living Marine Resources and play an important role identifying environmental change. The work of this group is regarded as high priority.
Scientific Justification:	<p>a) There is strong case to support the proposed meeting in order to review the links between physical forcing and the response of phytoplankton with particular regard to continued developments of new generations of coupled physical-biological and ecosystem models and also with regard to climate change.</p> <p>b) The work of SGQAB and SGQAE continues to be of relevance to the members of the WGPE. Feedback to and from these study groups plays an important role in ensuring relevant expertise is available to the study groups and that WG member are well informed of developments.</p> <p>c) The SGPHYT was set up following a recommendation of the WGPE. The work of the SG in developing a phytoplankton check list is of direct interest to the work of the WGPE and benefits from its attention and feedback.</p> <p>d) The WG recognises the need to ensure that relevant web links are brought to the attention of ICES and this action sets out to ensure that the process is given due attention.</p> <p>e) The workshop is required because there is a lack of agreement on the response of the planktonic ecosystem to anthropogenic forcing and in particular to nutrient inputs. Despite much effort in monitoring inputs and the response of the planktonic communities identifying quantitative links has proved very difficult. Furthermore, where ecosystem changes occur it is very difficult to distinguish between natural, anthropogenic or climatic in origin causes. The lack of consensus inhibits agreement in such international fora as OSPAR and hinders the process of sound policy development and so the aim of this workshop is to remedy this.</p> <p>f) Flagellates are important in planktonic ecosystems and are often the prime beneficiary of increased nutrient input into coastal ecosystems. Quantification of flagellate bloom dynamics is therefore required to improve ecosystem models. The controlled conditions within a mesocosm provide the means of measuring aspects of flagellate physiology and behaviour that are difficult to measure in the field.</p> <p>g) The joint meeting between WGPE and WGZE is very welcome and timely. Many of the issues which the WGZE is dealing with will benefit from a wider, collaborative approach. The development of working links between both groups has been mentioned frequently in the past and this is an excellent opportunity to tackle a well-defined agenda of common interests.</p>
Relation to Strategic Plan:	This working groups activities embrace all elements of the scientific objective of understanding the physical, chemical, and biological functioning of marine ecosystems.

Resource Requirements:	The Working Groups programme encompass the ongoing work of all its members, hence there are no additional resource requirements beyond those required for the meeting.
Participants:	The group has identified a need to encourage wider participation and especially to draw in relevant experts in areas of specific interest as required. A joint meeting with the WGZE in 2001 should provide a focal point to draw in new participants for this meeting with the opportunity to encourage participation in future meetings.
Secretariat Facilities:	None required
Financial:	None
Linkages to Advisory Committees:	The Group reports to ACME, mainly for the provision of scientific information on phytoplankton and their role in ecosystem function.
Linkages to Other Committees or Groups	Members of the WGPE are active participants in range of other committees and groups including SGQAB, SGQAE and SGPHYT
Linkages to Other Organisations	Members of this group are also active in HELCOM and EuroGOOS

## 12 CLOSE OF THE MEETING

The meeting of the Working Group on Phytoplankton Ecology closed at 17.30 hours on 7th April 2000.

## ANNEX 1 LIST OF PARTICIPANTS

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Peter Bot				

## **ANNEX 2      TERMS OF REFERENCE**

- a) identify the facilities, resources and protocols required to conduct a mesocosm experiment on flagellate physiology and behaviour;
- b) prepare for a joint session with WGZE in 2001 on the development of improved understanding of phytoplankton-zooplankton interactions;
- c) assemble a list of long-term time series of plankton and associated environmental variables and to discuss the possible development of an ICES-wide database on these parameters;
- d) develop proposals for a workshop on the role of anthropogenic forcing in planktonic ecosystem change to be held in 2001;
- e) develop criteria for inclusion of species in the phytoplankton checklist and to circulate it for comments;
- f) review the reports of SGQAB/SGQAE;
- g) consider and, where feasible, develop data products and summaries that can be provided on a routine basis to the ICES community via the ICES website;
- h) examine the 1999 Oceanography Committee Working Group reports and the Terms of Reference for 2000 to identify where inter-group input could be provided or required with the view to formulating key questions requiring inter-disciplinary dialogue during concurrent meetings of the Committee's Working Groups in 2002.



### ANNEX 3 AGENDA

Date	Start	Finish	Topic
5 <sup>th</sup>	09:00	09:15	Welcome by Assistant Dean of Faculty ?
	09:15	09:30	Housekeeping tasks and late breaking news
	09:30	10:30	Examine Oceanography Committee WG reports and TOR for 2000 (TOR h) Rapporteur Sebastian
	10:30	10:45	<i>Coffee break</i>
	10:45	11:45	Review the reports of SGQAB/SGQAE (TOR f)
	11:45	12:45	Data products for ICES (TOR g)
	12:45	13:45	<i>Lunch</i>
	13:45	15:30	Phytoplankton checklist (TOR e)
	15:30	15:45	<i>Tea break</i>
	15:45	17:15	Open session – updates by WG members
6 <sup>th</sup>	09:00	10:30	ICES database for long term time series (TOR c) Rapporteur: Francisco Rey
	10:30	10:45	<i>Coffee break</i>
	10:45	12:45	Develop Workshop proposal (TOR d) Rapporteur: Peter Bot
	12:45	13:45	<i>Lunch</i>
	13:45	15:45	Series of 4 presentations with discussion
	15:45	16:00	<i>Tea break</i>
	16:15	17:15	Mesocosm Study (TOR a) Rapporteur: Ted Smayda
7 <sup>th</sup>	09:00	10:30	Joint meeting with WGZE (TOR b) Rapporteur
	10:30	10:45	<i>Coffee break</i>
	10:45	12:45	Preparation of report
	12:45	13:45	<i>Lunch</i>
	13:45	14:45	Preparation of report
	15:30	15:45	<i>Tea break</i>
	15:45	16:30	Date of next meeting and AOB

## ANNEX 4 COMMENTS ON ANNEX 8 OF SGQAE REPORT 2000

The following key definitions were re-defined by WGPE:

**Phytobenthos.** Benthic flora.

**Phytoplankton.** ‘Chlorophyll-containing’, autotrophic, free floating organisms (mainly microalgae) in aquatic systems.

**Primary production.** Formation of organic material by photosynthesis.

*NB maybe need additional column on Sampling Strategy diversity. E.g. fixed point (mooring/bottom lander), ship lowered package, ship towed, ferry box*

*Chlorophyll-a should be chlorophyll throughout in order to acknowledge that fact that chromatography is required to separate chlorophyll-a from a non-photosynthetically active pigment chlorophyllide-a.*

### APPENDIX 1 of SGQAE Report 2000

**Critical QA factors and priority QA actions for monitoring Chlorophyll, Phytoplankton, Macrozoobenthos, and Macrophytobenthos**

**Table 1. Chlorophyll**

Steps	Method diversity	Critical QA factors	Priority QA actions
Sampling procedures	3–4 methods according to JAMP Guidelines - pump/hose - bottle sampler - <i>in situ</i> fluorescence	Variability in accuracy among methods (effectiveness of methods in coping with patchiness). <i>Is a combination of method and strategy</i>	Intercomparisons (workshops) on sampling method performance: eg. hose vs. bottle sampler vs. <i>in situ</i> fluorescence
Sample analysis	2 (3) principles recommended  different QA procedure for chlorophyll <i>a</i> extracts - spectrophotometer - fluorometer -HPLC as clean-up option	Accuracy and precision.	Certified reference material International calibration Calibration of <i>in situ</i> measurements (if <i>in situ</i> fluorometers are used, they should be calibrated with extracted chlorophyll)
Data treatment	Low variety of statistical methods		Reporting of data should be followed by control charts

**Footnote.** Supplementary variables for interpretation of chlorophyll results may include: phytoplankton, suspended particulate matter, particulate nitrogen and phosphorus, particulate organic carbon, temperature, salinity, and light penetration.

**Table 2. Phytoplankton**

Steps	Method diversity	Critical QA factors	Priority QA actions
Sampling procedures	High (4) - water bottles - hose - pumps - nets - autosamplers	Large variability in accuracy between methods especially among nets. (nets qualitative only)	Intercomparison of methods
Treatment and storage of samples	High (4–6) - different fixatives - living samples - time of storage	Algae may be impossible to identify as a result of group-specific fixation damage Other storage damage e.g. contact with surface	Intercomparison of fixative effects
Concentration of samples	High (4) - sedimentation - centrifugation - filtration - no concentration	Large variability in accuracy between methods (concentration dependant, species dependent). I	Intercomparison of methods Aim at uniform methods  General comment on this field is that what do we do with outcome of intercomparison and its impact on the methods
Sample analysis	Use of light microscope offers different techniques such as: - brightfield - darkfield - phase-contrast - epifluorescence interference contrast Automated analysis Flow cytometry Image analysis Species identification	Magnification. Quality of optics (resolution).  System design: System design: effective algorithms Taxonomic expertise. Change of species names (Synonyms).	Intercomparison exercises (never compare different microscopes!) Control of optical quality  Training and intercomparison exercises Ring tests Common check list including synonyms
Biomass transformation	Two main methods: - cell measurements - use of standard volumes	Large variability in size for the same species. Volumes based on preserved small e.g. nanoflagellates may be underestimates	Use of standard geometric cell shapes Establish lists of standard formulaes and volumes
Data treatment	Use of ‘control charts’ with relevant information accompanying the data. Tracking accuracy of measurement is difficult as there is no standard.	Simplicity and uniformity of control charts.	Develop and maintain control charts

**Footnote.** Supplementary variables for interpretation of phytoplankton results may include: chlorophyll, dissolved plant nutrients, particulate and total organic carbon, particulate organic nitrogen, temperature, salinity, and light penetration.

General point we think this list is too long and includes variables not essential for interpretation of phytoplankton data. This list must be under user control and depends on nature of monitoring exercise.

## APPENDIX 2 OF SGQAE REPORT 2000

### Good practice in the sampling and analysis of phytoplankton and chlorophyll.

#### Sampling

- Be sure the sampling and analysis personnel is well informed about sample location, type of sample and sampling method;
- Avoid contamination with sediment;
- Register date, time and any other co-variable like water temperature, salinity and extinction;
- Keep the samples in the dark and cool;
- Fixed (phytoplankton) samples: fixate immediately, avoid big air bubbles, mix gently, do not shake the bottle;
- Non-fixed (living) samples for qualitative analysis of phytoplankton: keep the samples in the dark and cool. Analyze the samples within 48 hours.

#### Phytoplankton analysis

- Take a sub sample in case there is a need to count a non-concentrated sample;
- Make use of a determination protocol and fill in completely;
- Create and maintain an annotated species list that contains the Latin name, synonym, historic information, morphologic description, measures and determination literature;
- Enumeration should be based on at least 50 cells for the common species. The total count should exceed 500. All cells should be counted and reported, even if fewer counted units progressively will decrease the precision of the count and increase the statistical error. (*This is taken from the Combine Manual*)
- Control chart.

#### Chlorophyll analysis (HPLC-method)

- Validate the HPLC-system (linearity, reproducibility, etc.). Validation is done at least once a year and when the system changes (new lamp, detector, etc) and is logged;
- Reference sample. The amount of reference sample should be enough for 2 months or 40 days;
- Control-chart. Chlorophyll-a content of the reference sample is registered on a control chart;
- Performance criteria HPLC-analysis:
- Column pressure: is allowed to vary between a certain range. Double check the peak shapes;
- Background signal detector: should be stable at a certain level;
- Retention time standard components chlorophyll-a/b and phaeophytine-a/b: check the location of the peaks, take action when there is a deviation of more than 10%;
- Response factor standard components: should not deviate more than 10% (compared with the last day).